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APPLICATION

FOR UNITED STATES LETTERS PATENT

SPECIFICATION

TO ALL WHOM IT MAY CONCERN:

BE IT KNOWN THAT WE, **Paul A. Knight**, a citizen of Canada, and **Brent M. Fales**, a citizen of the United States, have invented a new and useful spray cool system with a dry access chamber of which the following is a specification:

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Spray Cool System With A Dry Access Chamber

CROSS REFERENCE TO RELATED APPLICATIONS

Not applicable to this application.

**STATEMENT REGARDING FEDERALLY
SPONSORED RESEARCH OR DEVELOPMENT**

Not applicable to this application.

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates generally to spray cool thermal management systems and more specifically it relates to a spray cool system with a dry access chamber for providing convenient access to specific spray system components in a dry chamber separate from the wet chamber.

1 **Description of the Related Art**

2

3 Modern electronic devices have increased thermal management requirements.
4 Conventional dry thermal management technology simply is not capable of efficiently
5 cooling modern high-end electronics.

6

7 Spray thermal management technology is being adopted today as the most efficient
8 option for thermally managing electronic systems. United States Patent No. 5,220,804
9 entitled High Heat Flux Evaporative Spray Cooling to Tilton et al. describes the earlier
10 versions of spray technology. United States Patent No. 6,108,201 entitled Fluid Control
11 Apparatus and Method for Spray Cooling to Tilton et al. also describes the usage of spray
12 technology to cool a printed circuit board. Spray thermal management may be performed
13 locally (i.e. where the chip is sprayed directly), globally (i.e. where the chip and
14 surrounding electronics/boards are also sprayed), a combination of locally and globally, or
15 in conjunction with air cooling or other cooling methods. In a spray thermal management
16 system, most if not all of the spray components are contained within the spray chassis such
17 as but not limited to the spray unit, the card cage, valves, pumps, filters, separators and the
18 like.

19

20 While there are many benefits in utilizing spray technology, there are some
21 detriments. A significant problem with conventional spray technology is that to
22 replace, repair or test any electronic device the seal must be broken to the spray chassis
23 thereby leading to the loss of coolant. A further problem with conventional spray
24 technology is that when accessing the components, the user will often times come in
25 direct contact with coolant. Another problem with conventional spray technology is that
26 it requires all of the components to be coolant tolerant thereby increasing the overall cost of
27 the spray cool unit. Another problem with conventional spray technology is that many of
28 the dielectric cooling fluids absorb moisture from ambient air resulting in a risk of
29 electrical shorting spray cooled electrical components.

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2 While these devices may be suitable for the particular purpose to which they
3 address, they are not as suitable for providing convenient access to specific spray
4 system components in a dry chamber separate from the wet chamber. Conventional
5 spray cool systems do not have a separate dry chamber for providing convenient access
6 to spray system components such as pumps, filters, heaters, separators, sensors and the
7 like.

8

9 In these respects, the spray cool system with a dry access chamber according to
10 the present invention substantially departs from the conventional concepts and designs
11 of the prior art, and in so doing provides an apparatus primarily developed for the
12 purpose of providing convenient access to specific spray system components in a dry
13 chamber separate from the wet chamber.

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2 **BRIEF SUMMARY OF THE INVENTION**

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4 In view of the foregoing disadvantages inherent in the known types of spray
5 cool systems now present in the prior art, the present invention provides a new spray
6 cool system with a dry access chamber construction wherein the same can be utilized
7 for providing convenient access to specific spray system components in a dry chamber
8 separate from the wet chamber.

9

10 The general purpose of the present invention, which will be described
11 subsequently in greater detail, is to provide a new spray cool system with a dry access
12 chamber that has many of the advantages of the spray cool systems mentioned
13 heretofore and many novel features that result in a new spray cool system with a dry
14 access chamber which is not anticipated, rendered obvious, suggested, or even implied
15 by any of the prior art spray cool systems, either alone or in any combination thereof.

16

17 To attain this, the present invention generally comprises a chassis having a dry
18 chamber and a wet chamber. A dry access door and a wet access door are removably
19 attached about the dry chamber and the wet chamber respectively for providing access
20 to the same. Spray cool components such as a card cage and a spray unit are
21 positioned within the wet chamber. Spray cool components such as but not limited to
22 filters, pumps, heaters, sensors, separators and the like are positioned within the dry
23 chamber for efficient dry access.

24

25 There has thus been outlined, rather broadly, the more important features of the
26 invention in order that the detailed description thereof may be better understood, and
27 in order that the present contribution to the art may be better appreciated. There are
28 additional features of the invention that will be described hereinafter and that will form
29 the subject matter of the claims appended hereto.

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In this respect, before explaining at least one embodiment of the invention in detail, it is to be understood that the invention is not limited in its application to the details of construction and to the arrangements of the components set forth in the following description or illustrated in the drawings. The invention is capable of other embodiments and of being practiced and carried out in various ways. Also, it is to be understood that the phraseology and terminology employed herein are for the purpose of the description and should not be regarded as limiting.

A primary object of the present invention is to provide a spray cool system with a dry access chamber that will overcome the shortcomings of the prior art devices.

A second object is to provide a spray cool system with a dry access chamber for providing convenient access to specific spray system components in a dry chamber separate from the wet chamber.

Another object is to provide a spray cool system with a dry access chamber that reduces coolant loss by reducing the required access to the spray chamber.

An additional object is to provide a spray cool system with a dry access chamber that eliminates the need for a user to come in contact with coolant when accessing specific spray system components.

A further object is to provide a spray cool system with a dry access chamber that provides a location for components that are not compatible with spray cooling fluid.

1 Another object is to provide a spray cool system with a dry access chamber that
2 reduces the amount of time required to make repairs to specific spray system
3 components.

4

5 Another object is to provide a spray cool system with a dry access chamber that
6 provides environmental isolation for the components within a dry chamber.

7

8 Another object is to provide a spray cool system with a dry access chamber that
9 reduces the introduction of water into the cooling fluid and prolongs the life of water
10 removing filters.

11

12 Other objects and advantages of the present invention will become obvious to the
13 reader and it is intended that these objects and advantages are within the scope of the
14 present invention.

15

16 To the accomplishment of the above and related objects, this invention may be
17 embodied in the form illustrated in the accompanying drawings, attention being called
18 to the fact, however, that the drawings are illustrative only, and that changes may be
19 made in the specific construction illustrated and described within the scope of the
20 appended claims.

1
2 **BRIEF DESCRIPTION OF THE DRAWINGS**
3

4 Various other objects, features and attendant advantages of the present
5 invention will become fully appreciated as the same becomes better understood when
6 considered in conjunction with the accompanying drawings, in which like reference
7 characters designate the same or similar parts throughout the several views, and
8 wherein:
9

10 FIG. 1 is a side view of the present invention.
11

12 FIG. 2 is a side view of the present invention with a condenser positioned
13 within the wet chamber.
14

15 FIG. 3 is a side view of the present invention with the dry access door opened.
16

17 FIG. 4 is a perspective view of the present invention with the dry access door
18 and the wet access door closed.
19

20 FIG. 5 is a perspective view of the dry access door removed exposing the dry
21 chamber.
22

23 FIG. 6 is a right perspective view of the present invention with the dry access
24 door and the wet access door removed thereby exposing the dry chamber and the wet
25 chamber.
26

27 FIG. 7 is a left perspective view of the present invention with the dry access
28 door and the wet access door removed thereby exposing the dry chamber and the wet
29 chamber.

1

2 FIG. 8 is a front view of the present invention with the access doors removed.

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4 FIG. 9 is a front view of the present invention with a condenser within the wet
5 chamber.

6

1
2 **DETAILED DESCRIPTION OF THE INVENTION**

3 **A. *Overview***

4 Turning now descriptively to the drawings, in which similar reference
5 characters denote similar elements throughout the several views, FIGS. 1 through 9
6 illustrate a spray cool system with a dry access chamber **10**, which comprises a dry
7 access chamber includes a chassis **20** having a dry chamber **50** and a wet chamber **60**.
8 A dry access door **22** and a wet access door **24** are removably attached about the dry
9 chamber **50** and the wet chamber **60** respectively for providing access to the same.
10 Spray cool components such as a card cage **32** and a spray unit **30** are positioned
11 within the wet chamber **60**. Spray cool components such as but not limited to filters
12 **39**, pumps, heaters **33**, sensors **31**, separators **38** and the like are positioned within the
13 dry chamber **50** for efficient dry access.

14
15 **B. *Chassis***

16 The chassis **20** may have various shapes, structures and configurations. The
17 chassis **20** illustrated in the drawings should not be interpreted to limit the scope of
18 protection of the present invention.

19
20 As shown in Figures 1 through 3 and 6 through 9 of the drawings, the chassis
21 **20** has a wet chamber **60** and a dry chamber **50**. The dry chamber **50** includes a
22 coolant system fluidly connected to the wet chamber **60** for providing pressurized
23 liquid coolant (dielectric or non-dielectric). The dry chamber **50** is environmentally
24 isolated and conducts heat generated within the walls of chassis **20**.

25
26 The wet chamber **60** is for thermally managing an electronic device by
27 applying liquid coolant to an electronic device within the wet chamber **60**. The wet
28 chamber **60** and the dry chamber **50** are preferably adjacent to one another within the
29 chassis **20** in a sealed manner to prevent coolant from escaping the wet chamber **60**

1 and entering the dry chamber **50**. Various configurations may be utilized to provide
2 easy access to the dry chamber **50**.

3 4 **C. Access Doors**

5 As shown in Figures 4 and 5 of the drawings, a wet access door **24** is removably
6 attached about the wet chamber **60** for selectively sealing and opening the wet chamber
7 **60**. The wet access door **24** preferably includes a seal structure for sealing the wet
8 access door **24** about the wet chamber **60**. The wet access door **24** may be pivotally
9 attached or removably attached to the chassis **20**. Various fasteners may be utilized to
10 secure the wet access door **24** to the chassis **20** to close the wet chamber **60**.

11
12 As shown in Figures 1 through 4 of the drawings, a dry access door **22** is
13 removably attached about the dry chamber **50** for selectively sealing and opening the
14 dry chamber **50**. The dry access door **22** preferably includes a seal structure for sealing
15 the dry access door **22** about the dry chamber **50**. The seal of dry chamber **50** keeps
16 the contents of dry chamber **50** isolated from potentially harsh ambient conditions such
17 as but not limited to electromagnet interference (EMI), water, salt water, chemicals,
18 chemical warfare agents and the like.

19
20 The dry access door **22** may be pivotally attached (as shown in Figures 1
21 through 3) or removably attached (as shown in Figures 4 and 5) to the chassis **20**.
22 Various fasteners may be utilized to secure the dry access door **22** to the chassis **20** to
23 close the dry chamber **50**.

24 25 **D. Coolant System**

26 As stated previously, the dry chamber **50** stores the coolant system. The
27 coolant system is fluidly connected to a spray unit **30** positioned within the wet
28 chamber **60** as shown in Figures 1 through 3 of the drawings.

1 The coolant system is capable of thermally conditioning and filtering the return
2 coolant prior to returning the same to the spray unit 30. The coolant system may
3 include but is not limited to a filter 39, a pump, a heater 33, a sensor and/or a separator 38
4 as shown in Figures 1 through 3 of the drawings. Access to the coolant system is achieved
5 by removing the dry access door 22 without having to disturb the seal of the wet access
6 door 24 to the wet chamber 60.

7
8 When an individual opens the wet chamber 60, moisture is introduced into the
9 spray system which many dielectric cooling fluids, such as FLOURINERT®, absorb.
10 Moisture within the cooling fluid presents a risk to performance of the electrical systems
11 within wet chamber 60 by electrical shorting electrical components. The filter 39 is used to
12 remove water from the cooling fluid. The filter 39 must be replaced within a period that is
13 a function of the number of times, and length of time, that the cooling fluid is exposed to
14 the ambient air. The dry chamber 50 decreases the number of times the wet chamber 60 is
15 accessed thereby increasing the period of time between filter replacements and decreasing
16 the risk of electrical shorts within the system.

17 18 ***E. Coolant Spray System***

19 As stated previously, the wet chamber 60 stores the coolant spray system. The
20 coolant spray system is fluidly connected to the coolant system within the dry chamber
21 50. The coolant spray system may include but is not limited to a spray unit 30, a sensor,
22 a card cage 32, an intake valve 36 and/or a condenser 40. Various well-known coolant
23 spray systems may be utilized within the wet chamber 60.

24 25 ***F. Operation of Invention***

26 In use, the intake valve 36 within the wet chamber 60 draws the return coolant
27 through a separator 38 and/or filters 39 as shown in Figures 1 through 3 of the
28 drawings. The coolant is then passed through sensors 31 which determine the
29 condition of the coolant (e.g. temperature, contamination, etc.). The coolant may then

1 be passed through a heater 33 and/or a heat exchanger for thermal conditioning of the
2 coolant to a desired temperature. The coolant is then passed through a pump unit 34
3 which forces the coolant to the spray unit 30 for dispersing the coolant upon the
4 electronic devices within the wet chamber 60 as shown in Figures 1 through 3 of the
5 drawings. A condenser 40 within the wet chamber 60 assists in returning any coolant
6 vapor to a liquid state as shown in Figure 2 of the drawings.

7
8 If the user requires access to a component within the coolant system, the user
9 simply opens or removes the dry access door 22 as shown in Figures 3 and 5 of the
10 drawings. The user is then able to access the components of the coolant system
11 without disrupting the seal to the wet chamber 60. In addition, while the user is
12 accessing the dry chamber 50, the coolant system and coolant spray system may
13 continue operation without being disturbed.

14
15 As to a further discussion of the manner of usage and operation of the present
16 invention, the same should be apparent from the above description. Accordingly, no
17 further discussion relating to the manner of usage and operation will be provided.

18
19 With respect to the above description then, it is to be realized that the optimum
20 dimensional relationships for the parts of the invention, to include variations in size,
21 materials, shape, form, function and manner of operation, assembly and use, are
22 deemed to be within the expertise of those skilled in the art, and all equivalent
23 structural variations and relationships to those illustrated in the drawings and
24 described in the specification are intended to be encompassed by the present invention.

25
26 Therefore, the foregoing is considered as illustrative only of the principles of
27 the invention. Further, since numerous modifications and changes will readily occur to
28 those skilled in the art, it is not desired to limit the invention to the exact construction

- 1 and operation shown and described, and accordingly, all suitable modifications and
- 2 equivalents may be resorted to, falling within the scope of the invention.